

Comparison between pre- and post operative effects of intravenous anesthetic drugs on leukocytes: A clinical diagnostic study

Effects of intravenous anesthetic drugs on leukocytes

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Abstract

Aim: The leukocytes were affected by anesthesia and intravenous anesthetics. The purpose of this research was to examine the impact of these medicines preoperatively to evaluate the effects of intravenous anesthesia and anesthesia method on leukocytes, which are substantial immune system cells.

Material and Methods: One hundred participants who were recovering from surgery between November 2021 and March 2022 were the subject of the prognostic research. Before induction, a participant's blood was drawn, and six hours following the procedure, a further blood specimen was collected. For all specimens, complete blood count (CBC) tests were performed to determine leukocyte levels before and after surgery.

Results: In general, the mean neutrophil counts rose after surgery, whereas the mean lymphocyte, monocyte, eosinophil, and basophil counts declined. Leukocytes are more affected by general anesthesia than by other types of anesthesia. With the exception of pentothal, all hypnotic anesthetic medications affected the level of leukocytes. Individuals who received analgesics had a clear impact on leukocytes compared with those without analgesia. Moreover, leukocyte alterations for muscle relaxant have been observed; this resulted in lower cell, lymphocytes, monocytes, eosinophils and basophils levels but higher neutrophils counts. Most intravenous anesthesia showed substantial alterations when measured by neutrophil and lymphocyte count ($p < 0.05$).

Discussion: All analgesics, hypnotics, and muscle relaxants, with the exception of pentothal, may reduce lymphocytes, particularly cells. An increase in neutrophil levels could occur when intravenous anesthetics are given postoperatively.

Keywords

Anesthetic Drugs, General Anesthesia, Leukocytes, Pentothal, Propofol

DOI: 10.4328/ACAM.21683 Received: 2023-03-10 Accepted: 2023-05-05 Published Online: 2023-05-19 Printed: 2023-07-01 Ann Clin Anal Med 2023;14(7):625-629

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This study was approved by the Ethics Committee of College of Health and Medical Technology, Sulaimani Polytechnic University (Date: 2021-08-03, No: CH 00085)

Introduction

Anesthesia is the procedure of administering medicines to a person in order to keep them from pain during surgery or other medical care. The drug may be delivered using a variety of different techniques, including injection, topical lotion, eye drops, skin patches, and sprays. During medical treatments, these medications protect the body from experiencing any loss of sensation or consciousness. One of the most common types of pain medication, known as General Anesthesia (GA), induces forgetfulness and analgesic in patients, regardless of the temporary blindness of the muscles after administration of medications [1].

Sufficient depression of the neurological system, brought about by known GA, is necessary in order to perform intensive, factor involves issues or concerns treatments such as surgical procedures [2].

Intravenous (IV), inhalation, intravenous sedation, opiates, and antimetabolic medicines are the five main types of anesthetic drugs. Every person in the group has their own set of disadvantages when it comes to accomplishing the main objective of general anesthesia [3].

The beginning of modern intravenous anesthetics may be traced back to the introduction of Pentothal into the field of anaesthetic therapy. Nowadays, Propofol is the intravenous anesthetic used in clinical settings most frequently. Also at low dosages, Propofol may provide a sedative or antiemetic action, which is one of the drug's many advantages [4].

Anxiolysis, the induction of memory, and feeling drowsiness are the most common clinical applications of Midazolam. The most recent addition to the antidepressant family, Remimazolam, has an exceptionally brief term of action as a result of its rapid elimination via plasma esterases [4].

Analgesia was attained by the use of Ketamine. That was the very first-time medical anesthetic used this technique. Additionally, Fentanyl was the first created as an intravenous anesthetic; nonetheless, its most strong hypnotic analgesia has become of concern [5]. Both atracurium and rocuronium are examples of non-depolarizing muscle relaxants that are administered during anesthesia and have a transitional or rapid onset of action [6].

Leukocytes includes, Granulocytes (neutrophils, eosinophils, and basophils) and non-granulocyte (monocytes and lymphocytes) that are components of the immune system, which help the human body to invade or resist infection and other diseases [7, 8].

The purpose of the prescription of hypnotic medicines preoperatively is to generate sedation, which affects the hematological and immunological systems, particularly leukocytes [9].

The immune system is made up of a complex structure of molecules, and lymphocytes are one of them that function together to safeguard the body from hazardous microorganisms. They have a capacity to immediately distinguish every disease and infectious cell in addition to remembering them. Allergy, predisposing factors, and inflammatory disorders may all be produced by immune response imbalances [10].

Throughout the course of breakthroughs in fundamental research as well as enhancements in laboratory activities, such

as tissue culture and procedures for the segregation of tissues, several types of general anesthetic have been demonstrated to possess the ability to reduce the immune response's activity. Anesthesia-induced immunosuppression,, which involves conformational changes in lymphocytes and suppression of natural killer cells, is particularly problematic for individuals with the majority of neoplasms [11].

According to the examination of the effect of anesthesia method on post-operative natural killer T cells, no differences were found between some of the spinal anesthesia crew and the minimal invasive GA crew [12].

Material and Methods

People who had recently undergone surgical procedures were the subjects of this retrospective clinical investigation. Consent after receiving appropriate information was obtained from every patient. From November 2021 to March 2022 we gathered data from a variety of facilities, including Shar Medical Center and Sulaimani Surgery Center.

The study was approved by the Research Ethics Committee of the College of Health and Medical Technology, Sulaimani Polytechnic University (Research study code CH 00085). Informed consent was obtained from all the subjects.

The 100 patients in this research, whose ages varied from 5 to 80, were randomly selected. Patients undergoing general anesthesia were given intravenous infusions of Propofol (2-3 mg/kg) or Pentothal (2-3 mg/kg) for initiation, and they were given either Fentanyl (0.5-2 g/kg) and or Ketamine (0.1-0.3 mg/kg) as analgesia. Medicaments and onset and development were given intravenously to participants. After anesthesia was administered, either rocuronium (0.6-1.2 mg/kg) or atracurium (0.5 mg/kg) was given as a muscle relaxant.

Participants who were about to receive spinal anesthesia were positioned so that they sit or lie on their side. Intrathecally, ten to fifteen milligrams of Bupivacaine and fifteen micrograms of Fentanyl were injected.

In addition, because of the lengthy nature of the surgery, other participants were given a combination of general anesthesia and spinal anesthesia for sleep with sedation [Midazolam (0.05-0.08)].

Blood was obtained to collect samples for examination prior to the procedure. The first findings were acquired during the day procedure, thirty minutes before the induction of anesthesia; the second blood sample was taken six hours after the operation. An implantable catheter was placed into a vein in the participant's forearm vein, and 5 milliliters (ml) of blood was collected from the midline of the cubital, cephalic, and basilic veins. The blood was then placed in an EDTA tube. Blood samples were used to obtain a CBC (complete blood count) test on a Colter-Medonic M51 machine with serial number (TF11041924093).

Inclusion criteria :, all participants had a normal white blood cell count before surgery and were healthy.

Exclusion criteria: individuals under the age of 5 and those who with abnormal white blood cell count were excluded from the study.

Analytical evaluations and information management were carried out using the Statistical Package for the Social Sciences (SPSS) version 22. The Chi-square test (χ^2) was utilized for

contrasting the categories. The work of establishing the relationship between the mean and the variables was carried out using the (ANOVA) test and the independent sample test. A statistically significant interaction between the factors was considered to exist if the P-value was much less than 0.05.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

A total of 100 participants were included in the research, including 36 male and 64 female individuals. The age range of the majority of the instances, which accounted for 55%, was 20-40 years.

Before the surgery, mean eosinophil levels were 66.75, but they increased to 81.08 after operation, the difference was 14.33. Lymphocytes count before the operation was 26.47, however this number dropped to 14.98 after the operation. Before the operation, the number of monocytes was 4.06, however, this number dropped to 2.64 after surgery. Before the procedure, eosinophils counts were 2.15; after the procedure, they dropped to 0.93. (Figure 1).

The mean level of lymphocytes in people undergoing GA was

Table 1. Comparison of mean leukocyte counts before and after the operation, depending on the type of hypnotics.

Leukocytes	Time of operation	Marcaïne	Midazolam	Propofol	Pentothal	P-value
		Mean	Mean	Mean	Mean	
Basophils	Pre	0.40	0.40	0.37	0.25	0.01
	Post	0.50	0.60	0.58	0.25	
Monocytes	Pre	3.3	6.20	2.41	4.15	0.07
	Post	3.25	4.80	4.23	2.65	
Neutrophils	Pre	77.86	58.40	82.47	75.00	<0.001
	Post	65.97	54.10	66.35	83.35	
Eosinophils	Pre	0.17	3.30	0.91	0.75	0.03
	Post	1.68	3.20	2.30	0.20	
Lymphocytes	Pre	18.15	31.70	13.81	19.85	<0.001
	Post	28.65	37.30	26.52	13.55	

Table 2. Mean Lymphocytes count pre- and post-operation with the types of analgesia.

Leukocytes	Time of operation	No drug	Ketamine	Ketamine + Fentanyl	Fentanyl	P-value
		Mean	Mean	Mean	Mean	
Basophils	Pre	0.37	0.38	0.30	0.32	0.8
	Post	0.48	0.57	0.60	0.52	
Monocytes	Pre	3.57	2.47	2.30	2.37	0.01
	Post	3.63	4.14	2.30	4.65	
Neutrophils	Pre	75.42	81.86	73.30	87.52	0.02
	Post	72.35	66.59	58.7	72.95	
Eosinophils	Pre	0.98	0.89	1.10	1.12	0.09
	Post	1.71	2.27	2.30	1.92	
Lymphocytes	Pre	27.76	14.38	23.10	8.65	<0.001
	Post	28.81	26.40	36.10	19.95	

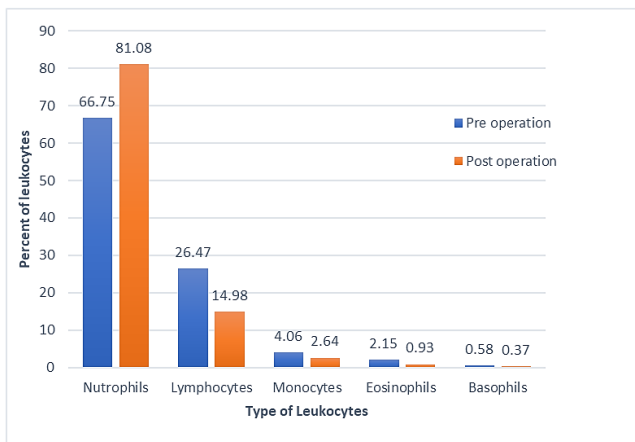


Figure 1. Comparison of leukocyte counts pre- and post-operation.

Table 3. Comparison between pre- and post-operation of mean leukocytes with the types of muscle relaxant.

Leukocytes	Time of operation	No drugs	Atracurium	Rocuronium	P-value
		Mean	Mean	Mean	
Basophils	Pre	0.37	0.51	0.34	0.9
	Post	0.51	0.62	0.55	
Monocytes	Pre	3.67	2.88	2.25	0.03
	Post	3.73	3.17	4.36	
Neutrophils	Pre	65.76	71.62	65.97	<0.001
	Post	75.57	80.32	83.03	
Eosinophils	Pre	1.97	1.68	2.31	0.6
	Post	1.24	0.92	0.83	
Lymphocytes	Pre	19.25	15.32	13.52	<0.001
	Post	28.3	22.88	26.77	

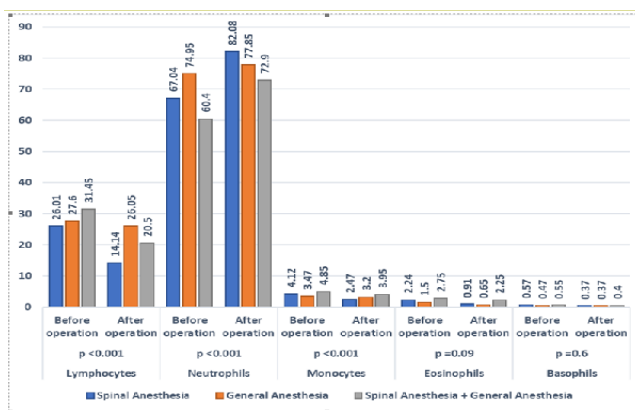


Figure 2. Distributions of mean leukocytes pre- and post-operation in relation to the types of anesthesia.

26.01 prior to surgery but decreased to 14.14 as a result of GA. Before the surgery, the mean for those handled with SA was 27.60; nevertheless, after the operation, it was 26.05. For patient populations in both SA and GA, the mean level also dramatically decreased. Regarding neutrophils, mean levels increased during surgery for participants who had GA, and SA+GA, 67.04 to 78.08 and 60.4 to 72.9, respectively; however, for those who underwent SA, smaller increases were found from 74.95 to 77.85. The p - value for such changes was less than 0.001, making them statistically significant for both lymphocytes and neutrophils (Figure 2).

The mean level of lymphocytes in participants who were given Propofol, Midazolam, and Marcaine during surgery was 26.52, 37.30, and 28.65; however, after surgery, these numbers dropped to 13.81, 31.70, and 18.15, accordingly. But the standard deviation increased from 13.55 to 19.85 for those who were given Pentothal. When it comes to neutrophils, the mean significantly improved following surgery for individuals who were given Propofol and Marcaine, with ranges of 66.35 to 82.47 and 65.97 to 77.86, respectively. The mean level, however, dropped after the procedure from 83.35 to 75.00 among individuals who were given Pentothal. The p - value for such changes was less than 0.001 for both lymphocytes and neutrophils, indicating that they were statically important (Table 1).

Based on the results that we obtained, the levels of lymphocytes, monocytes, eosinophils, and basophils all fell after the surgery at various rates; however, the levels of neutrophils rose after the operation in all individuals. Before and after the operation, the correlation between lymphocytes and analgesics was found to be significant (p-value <0.001), as well as the relationship between monocytes and neutrophils (neutrophil p-value = 0.02) and (monocyte p-value = 0.01); however, the p-value for eosinophils and basophils revealed that the validity was not significant (eosinophils=0.09; basophils=0.8). On the other hand, those who did not get analgesics showed any appreciable changes in the median frequencies for all leukocytes (Table 2). With regard to muscle relaxant, the levels of lymphocytes, monocytes, eosinophils, and Basophils reduced after the operation; however, the levels of neutrophils rose. Even so, there were no significant changes for eosinophils and basophils (p=0.6 and p=0.9), despite substantial correlations between lymphocytes and neutrophils with muscle relaxants before and after the operation (p-value 0.05) (Table-3).

Discussion

According to the findings of this particular research, the count of lymphocytes before operations was considered to be acceptable; nevertheless, the number dropped to pathological levels following anesthesia. It follows that anesthesia medications may have an effect on the cells in question. This finding is consistent with other previous studies, which suggested that anesthesia medicines may have an effect on the leukocytes and lower the count of lymphocytes after surgery. Patients who receive general anesthesia or combined spinal and general anesthesia have a more significant reduction in their lymphocytosis after surgery as a result of spinal anesthesia. On the other hand, patients receiving local anesthesia do

not experience any transition in their white blood cell count. In contrast, following surgery, the number of neutrophils in the blood of those who had general anesthesia, spinal anaesthesia, or both spinal and general anesthesia has been shown to increase. A significant relationship between these characteristics was revealed. This suggests that anesthetics have a negative impact on the immune system, and more research is recommended to confirm this impact. In addition, both clinical and experimental research have shown that anesthesia has the potential to negatively affect immunity [13-15]. When more than one type of anesthesia is combined with operations, there are a large number of variables that might contribute to a disruption in immune system. These variables include general disorders, the length of the operation, illness that is also implicated, as well as anesthesia medicines and procedures [16]. In general, anesthesia has the effect of suppressing the immune system [17].

These changes may occur as a reaction to the action of various hormones; additionally, lead to decline in monocyte, eosinophil and Basophils counts. After the operation, patients who have been administered complete intravenous anesthetics showed a decrease in their lymphocytosis at every observation period examined [15].

When the levels of leukocytes prior to and after anesthesia were analyzed, the researchers found that the use of hypnotics was related to a change in the level of lymphocytes. This result indicates or probably may be due to a decrease in the number of cells. It may also have to do with how the medications respond to different doses. Prior research concluded that the release of stromal hormonal and mediators could be responsible for the activation of the neuroendocrine system that occurs after anesthesia and surgical procedures [18, 19]. In addition, leukopenia may develop as a consequence of the administration of anesthetic as a result of a variety of hormones, cytokines, and acute-phase reactants, the death of cells, or inhibition of the mortality of lymphocytes [20]. In contrast to this, there was no change in the total number of leukocytes in patients sedated with Propofol and Fentanyl [17].

According to the outcome of this investigation, the frequency of neutrophils reaches its peak six hours after surgical intervention. Because of this, any anomalous substances that are interred into the human body and then come into contact with the macrophage and invade the drugs because they recognized those drugs as abnormal foreign bodies resulting in the elevation in the levels of neutrophils. Likewise, medicines have the potential to signify a foreign body and cause an interchange in the number of monocytes. Previous results have been quite close to being consistent with this finding [21]. It has been shown that the use of Propofol reduces the number of neutrophils, but the use of Pentothal and Midazolam led to an increase in macrophages [21]. The results of this study are consistent with those of the earlier research.

As a result, researchers compared the levels of monocytes before the procedure to the frequencies of monocytes after the surgery, and the research revealed that the various analgesics had an effect on the level of WBCs in the majority of instances. In addition, the level of all leucocytes except for neutrophils grew after the surgery. This is significant for two reasons: mainly,

macrophages (neutrophils) are regarded very first lines of strong protection against infections, and secondly, granulocyte have the capacity to safeguard patients from bacterial infections [14]. In many circumstances, a required and natural response of the body to an infection is a rise in the percentage of granulocyte (neutrophils). This increase in the number of macrophages is a required biological response [22]. According to the findings of our research, neutrophilic granulocytes and the enormous inflow of those cells into the circulation, along with leukocytes, cause depletion [23]. Additionally, Jafarzadeh and colleagues found that ketamine and fentanyl affect the immune system [9], and our research found comparable results. This result may have been influenced by the participants' ages, the duration of the procedures, or the sorts of operations. On the different side, there was only a minor percentage of an increase in the rates of leukocytes in individuals who did not get the analgesics (these participants underwent surgery under spinal anesthesia). Perhaps this is due to the method or type of treatment that was performed. Yet, some writers indicated that the anesthesia approach was associated with less change in the counts of leukocytes than with operation stress [15].

In regard to muscle relaxants, the level of (lymphocytes, monocytes, eosinophils and basophils) all reduced after the surgery, although the number of neutrophils has increased, and substantial variations are revealed between them. This shift most likely occurred as a result of the real effect that those medications had on monocytes, as well as the increased presence of pharmaceuticals that occurred as a result of those drugs being physically administered into the bloodstream. Prior research has reached the same result [15]. In addition, Sangwan and his colleagues came to the same opinion [24]. Nevertheless, the lymphocyte count changed less in individuals who were given general anesthesia instead of muscle relaxant (those under spinal anesthesia). This suggests that there were no suppressive impacts since they have never used intravenous anesthetics to induce anesthesia in these patients [24].

Conclusion

Individuals who have general anesthesia get a higher risk of having a reduction in their neutrophil count compared to individuals who get spinal anesthesia. Compared to other hypnosis and anesthesia medications, the efficiency of propofol and Marcaine in lowering cell counts is much higher. All analgesics and muscle relaxants that have been taken have the potential to produce inflammatory cell fractions, especially lymphocytes. Moreover, with the exception of Pentothal involving a specific, all anaesthetic medications have the potential to increase the number of neutrophil cells within the human organism.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:

Kamal Jalal Rashid, Safa Bakr Karim, Muhammed Babakir-Mina. Comparison between pre- and post operative effects of intravenous anesthetic drugs on leukocytes: A clinical diagnostic study. *Ann Clin Anal Med* 2023;14(7):625-629

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